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ABSTRACT

Young infants discriminate both native and nonnative phonetic contrasts, but 10- to 12-month-olds and adults fail to discriminate some nonnative contrasts. To explain this, Best, McRoberts, and Sithole (1988) hypothesized that at the age of 10-12 months, a phonological influence begins by means of which nonnative sounds are assimilated to native categories when possible, and are perceived in auditory or nonspeech terms when they are not assimilable. Best et al. tested English-language infants and adults on discrimination of a Zulu click contrast that was not assimilable to English phonological categories. As predicted, the clicks were discriminated up to 14 months and even into adulthood, suggesting that the perceptual reorganization toward the end of the first year reflects phonological development. The study by Best et al. had not directly compared single-category assimilable and non-assimilable contrasts. The present study compared English-learning infants' discrimination of the Zulu clicks and of a single-category assimilable contrast, the Thompson glottalized stops, and an English stop contrast. As expected, 6- to 8-month-olds discriminated the English and nonnative contrasts. However, 10- to 12-month-olds discriminated only the Zulu and English contrasts. These findings strengthen the evidence that the perceptual reorganization that occurs by 10-12 months reflects phonological development. (RH)

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Phonological Influence on Infants' Perception of Two Nonnative Speech Contrasts

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ABSTRACT

Young infants discriminate both native and nonnative phonetic contrasts, but 10-12 month-olds and adults fail to discriminate some nonnative contrasts (e.g., Werker & Tees, 1984). To explain this observation, Best, McRoberts, & Sithole (1988) hypothesized that a phonological influence begins around 10-12 months, whereby nonnative sounds are assimilated to native categories whenever possible, but are perceived in auditory or nonspeech terms when non-assimilable. Whereas previously-tested nonnative were characterized by assimilation to single native categories, yielding poor discrimination by 10-12 months, Best et al. tested English-language infants and adults on discrimination of a Zulu click contrast that was not assimilable to English phonological categories. As predicted, the clicks were discriminated up to 14 months and even into adulthood, suggesting that the perceptual reorganization toward the end of the first year reflects phonological development.

The Best et al. study had not, however, directly compared single-category assimilable and non-assimilable contrasts. Therefore, we compared English-learning infants' discrimination of the Zulu clicks and of a single-category assimilable contrast (Thompson glottalized stops), as well as an English stop contrast. As expected, 6-8 month-olds discriminated the English and both nonnative contrasts. However, 10-12 month-olds discriminated only the Zulu and English contrasts. These findings strengthen the evidence that the perceptual reorganization by 10-12 months reflects phonological development.

BACKGROUND

According to cross-language research on speech perception, younger infants discriminate both native and nonnative contrasts, whereas 10-12 month-olds fail to discriminate at least some nonnative contrasts (e.g., Werker & Tees, 1984). A recent study extended this work to English-learning infants' perception of Zulu clicks, to assess whether the perceptual reorganization at 10-12 months reflects some emerging influence of the native language's phonology upon perception (Best, McRoberts & Sithole, 1988). The authors reasoned that phonologically-based discrimination entails perceptual assimilation of nonnative contrasts to native phonological categories, and they proposed four possible types of assimilation (see Table 1). While earlier-studied contrasts were each assimilable to some single native category, and therefore difficult to discriminate, the click contrast was non-assimilable re: English phonology. As predicted, the clicks were easily discriminated by English-language listeners even at 12-14 months and into adulthood.

However, Best et al. had not directly compared non-assimilable and single-category assimilable contrasts. Moreover, the simpler test procedure and shorter interstimulus intervals than those used by Werker and Tees might possibly have aided click discrimination (Werker & Logan, 1985). Therefore, we compared 6-8 month-olds' and 10-12 month-olds' discrimination of Zulu clicks (non-assimilable) and of the Thompson (Native American) glottalized stop contrast (single-category assimilable) used by Werker & Tees. Subjects were also tested with an English stop consonant contrast. Younger infants were expected to discriminate all 3 contrasts, whereas older infants were expected to discriminate only the English and Zulu contrasts.

Table 1. Proposed Influence of Native Language Phonology on Speech Perception.

Types of Perceptual Assimilation for Nonnative Contrasts	Influence on Discrimination
1. Single-Category	**poor discrimination** both members of the nonnative contrast are perceived as (nearly) indistinguishable exemplars of a single native phoneme
2. Two-Category	**excellent discrimination** the two members of the nonnative contrast are perceived as similar to two different native phonemes
3. Category-Goodness Difference	**good discrimination** both members of the nonnative contrast are perceived as similar to a single native phoneme, but one is clearly a "good" exemplar while the other is a "poor" one
4. Non-Assimilable	**good discrimination** neither member of the nonnative contrast is perceived as similar to any native phoneme; they are heard instead as nonspeech sounds

METHODS

Subjects: Infants at ages 6-8 months and 10-12 months (12 per group) participated. All were normal, full term infants being raised in monolingual English environments.

Stimuli: All three tests used multiple naturally produced tokens of speech. The Zulu discrimination test used six amplitude equated tokens of the apical and lateral clicks /ǃa/ and /ǂa/ used in Best, McRoberts and Sithole (1988) (see Figure 1). The Thompson discrimination test used the six tokens of glottalized uvular and velar stops /k̓æ/ and /q̓æ/ used in Werker et. al. (1981) (see Figure 2). The English discrimination test used the six tokens of /ba/ and /da/ used in Werker et. al. (1981) and Best, McRoberts and Sithole (1988). The multiple tokens for each category provided for assessing some degree of within-category perceptual constancy.

Procedure: The infant-controlled visual habituation technique was used (Horowitz,1975; Miller, 1983; Best, McRoberts and Sithole, 1988), in which an initial series of auditory stimuli (familiarization set) is presented contingent on the subject's fixation of a projected visual pattern. Habituation to the familiarization set is indexed by a decrement in fixation to a criterion level (2 consecutive trials below 50% of the 2 longest preceding looks), at which point a shift to a new set of auditory stimuli (test set) occurs. A post-shift recovery of fixation time to the same visual target indicates discrimination between the familiarization and test stimuli. Subjects were tested on all three contrasts in a single session. The order of test presentation was counterbalanced. The infants were given a 5-10 minute break (if needed) between tests.

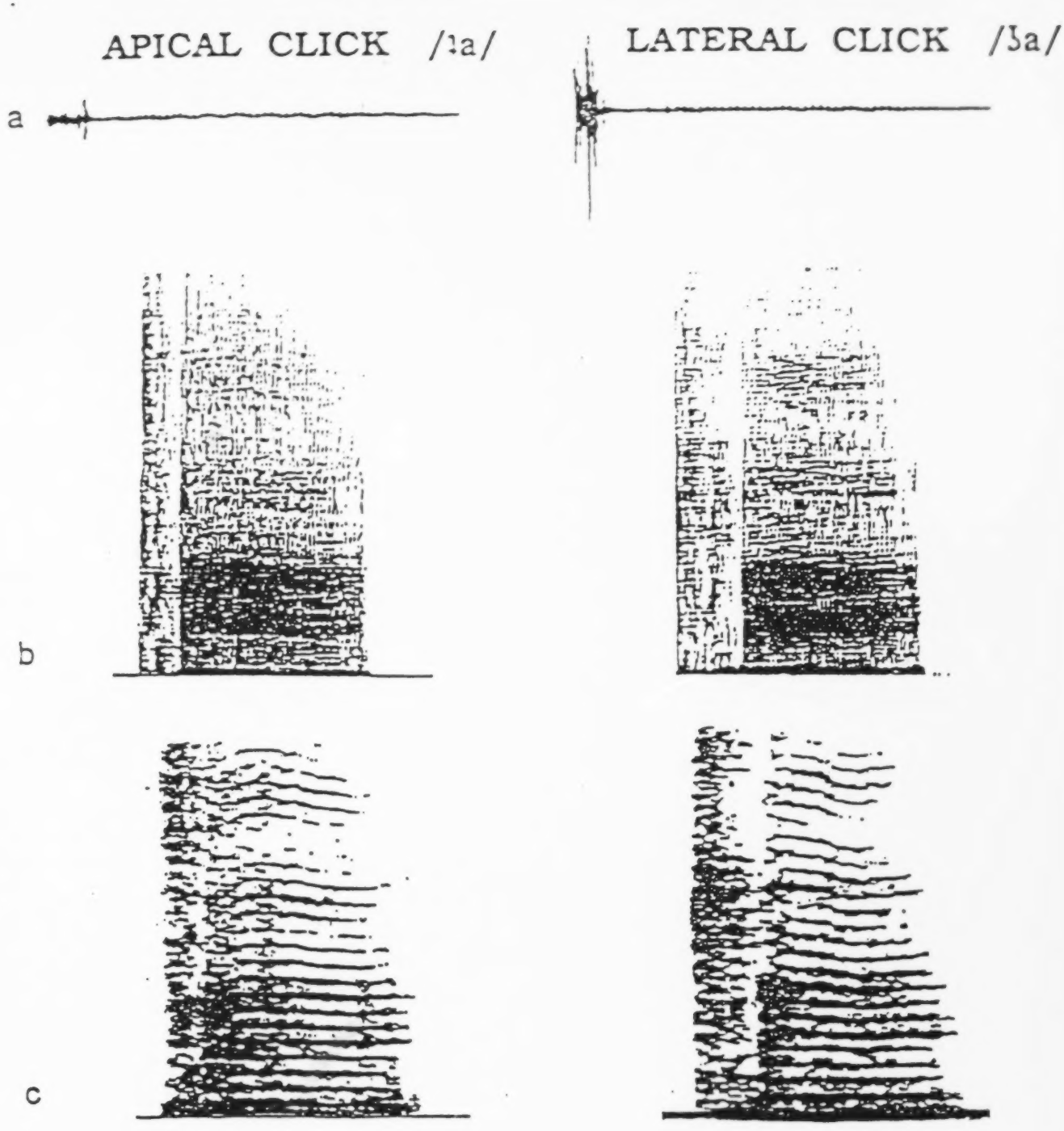

FIGURE 1. Panel a: oscillographic displays of a typical original (amplitude unmodified) voiceless unaspirated apical click (/ǃa/) and lateral click syllable (/ǁa/) from Zulu.
Panel b: wide-band spectrograms of the amplitude-equated versions of those syllables.
Panel c: narrow-band spectrograms (from Best, McRoberts & Sithole, 1988).

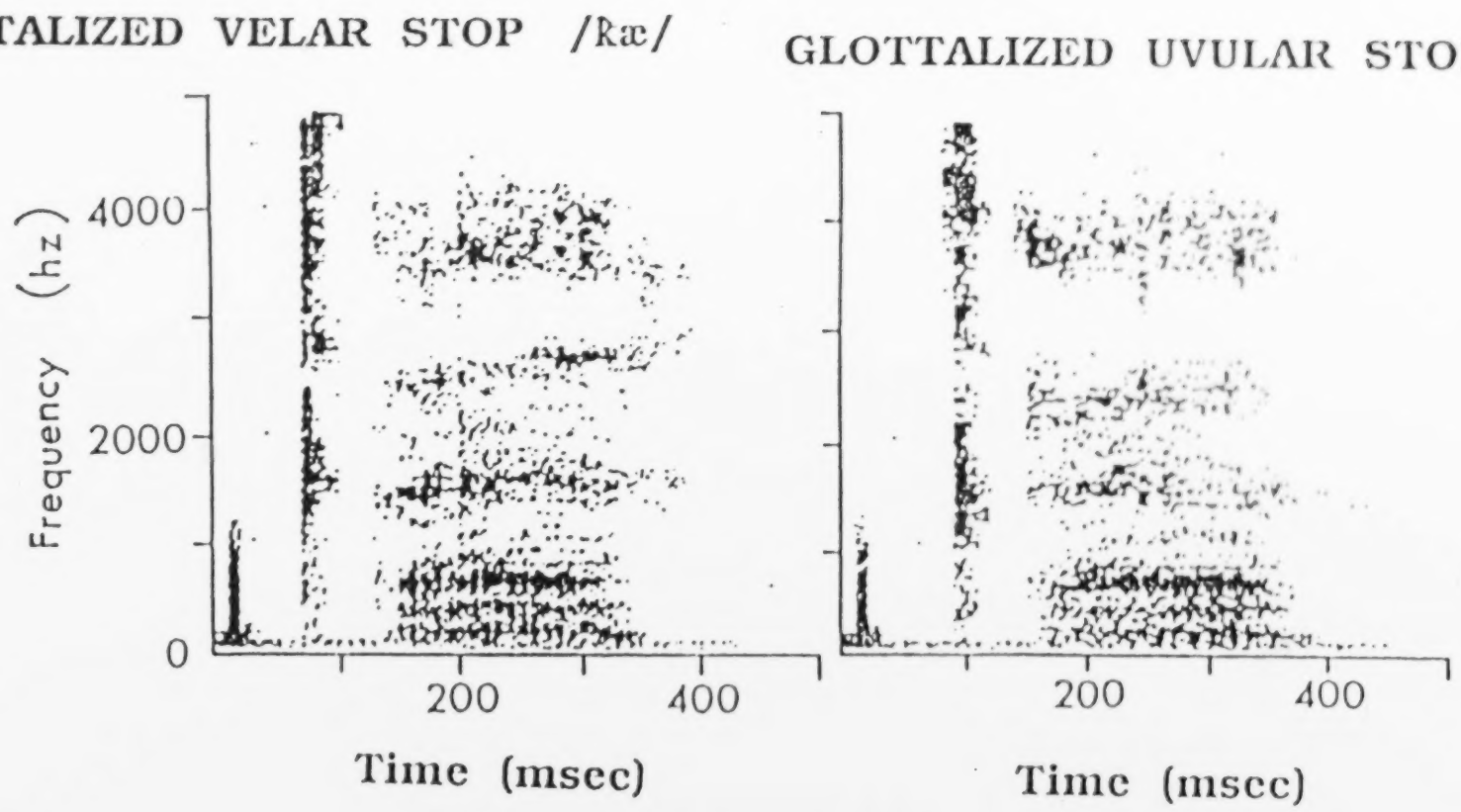

FIGURE 2. Wide-band spectrograms of typical exemplars of the Thompson glottalized velar-uvular contrast (/Ræ/-/ɢæ/) (from Werker & Tees, 1984).

RESULTS

Modified habituation curves are shown in Figures 3 and 4. The discrimination results are shown in Figure 5. The mean of each subject's last two pre-shift and first two post-shift trials on each test were entered into separate repeated measures ANOVAs for each age group, with Contrast (Zulu, Thompson, English) and Period (pre-shift, post-shift) as factors. For the 6-8 month old group, there were significant main effects for Contrast and Period, reflecting the fact that overall fixation times were greater for the English than the Thompson contrast, and that there was significant dishabituation across the three contrasts. Although the Contrast x Period interaction was not significant, we performed simple effects tests to assess our hypothesis that the 6-8 month old group would discriminate each contrast. These analyses indicated significant dishabituation for each contrast.

Contrast	DF	F	p
English	1,11	7.091	.02
Zulu	1,11	4.872	.05
Thompson	1,11	4.674	.05

For the 10-12 month old group, there was only a significant main effect for Period, reflecting significant dishabituation overall. The Contrast x Period interaction was only marginally significant, $F(2,22) = 2.676$; $p = .09$. However, given our a priori prediction that this age group would discriminate the English and Zulu contrasts, but fail to discriminate the Thompson contrast, we performed simple effects tests as above. These analyses indicated significant dishabituation for the English and Zulu contrasts, but not for the Thompson contrast.

Contrast	DF	F	p
English	1,11	10.528	.01
Zulu	1,11	5.691	.05
Thompson	1,11	ns	- -

CONCLUSIONS

The results upheld our predictions that older infants would discriminate a nonnative speech contrast that cannot be assimilated to the native phonology, but would fail to discriminate a nonnative contrast that is assimilable to a single native category, whereas younger infants would discriminate both types. The 6-8 month-olds discriminated the English control contrast and both nonnative contrasts. They did, however, show significantly lower attention to the Thompson sounds than to the English sounds overall, suggesting the possibility of a rudimentary phonological influence on perception even in this age group. More important, the 10-12 month-olds discriminated only the click contrast and the control contrast, and failed to reliably discriminate the Thompson contrast, as predicted. These findings strengthen earlier evidence that the developmental reorganization in infant speech perception during the second half-year reflects the emergence of phonological influences on speech perception.

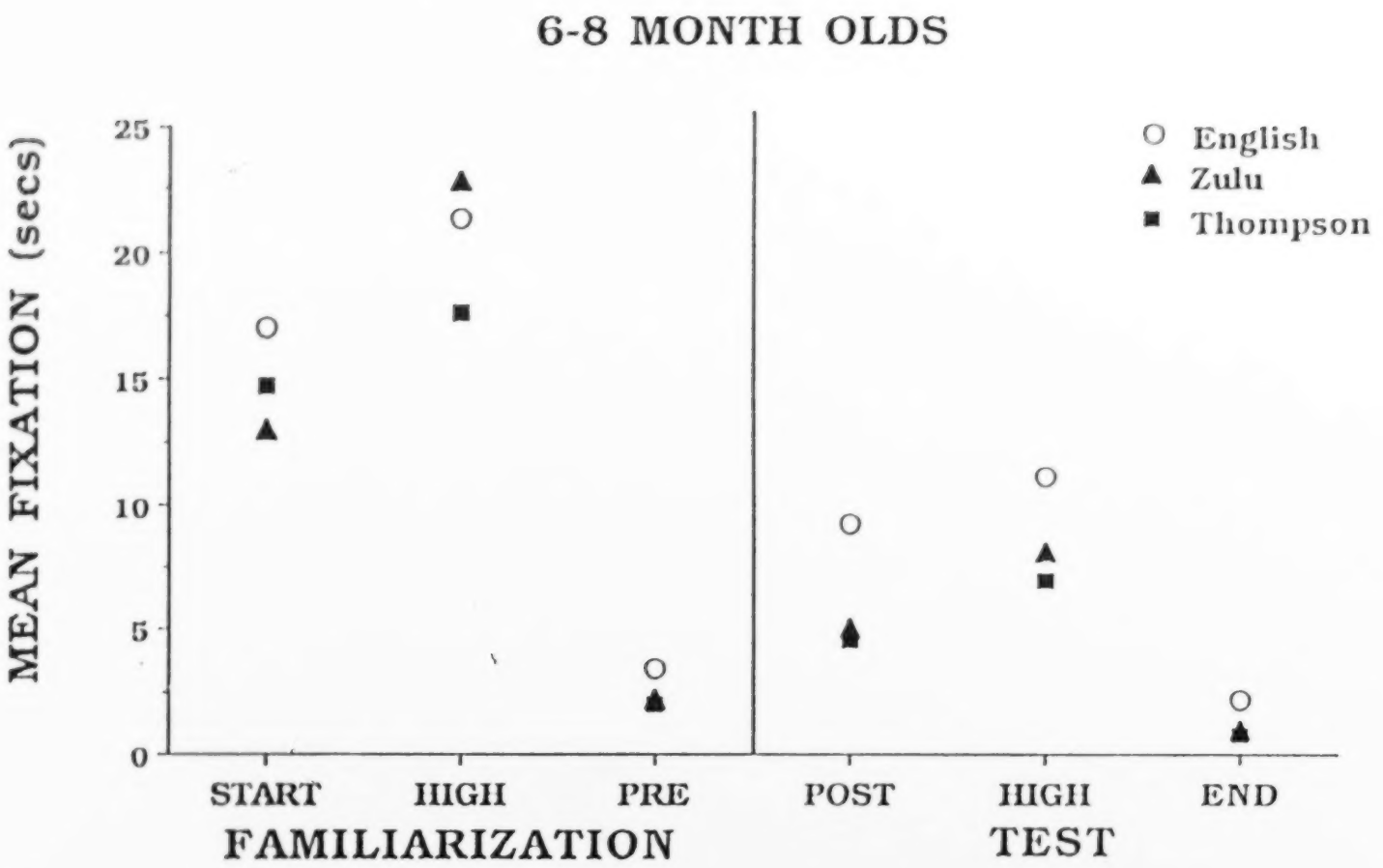

FIGURE 3. Mean fixation times for the first two, highest two, and final two trials in the familiarization phase and the test phase of each test by 6-8 month-olds. For some infants, the first two trials includes one or both highest trials.

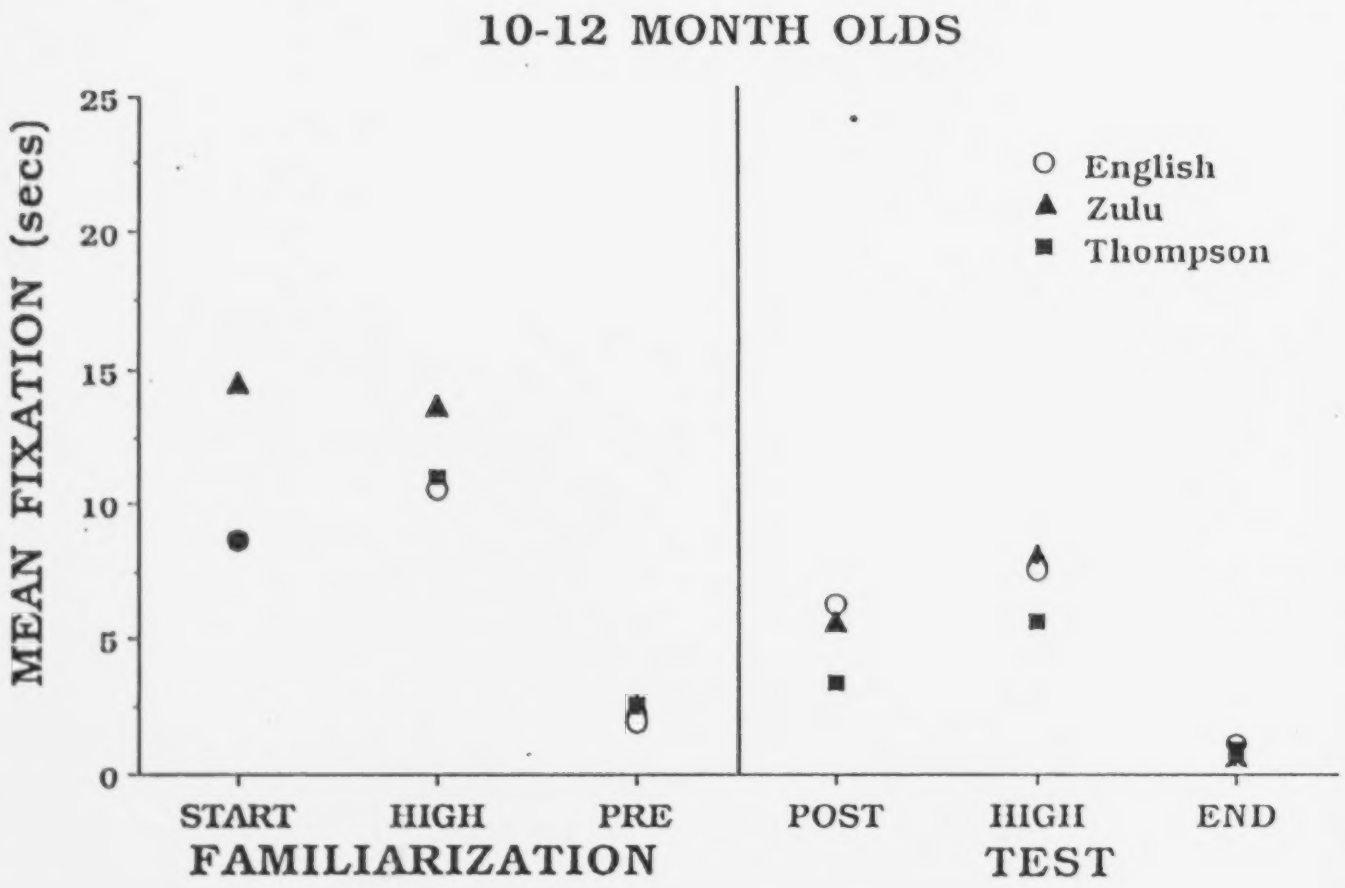

FIGURE 4. Mean fixation times for the first two, highest two, and final two trials in the familiarization phase and the test phase of each test by 10-12 month-olds. For some infants, the first two trials include one or both highest trials.

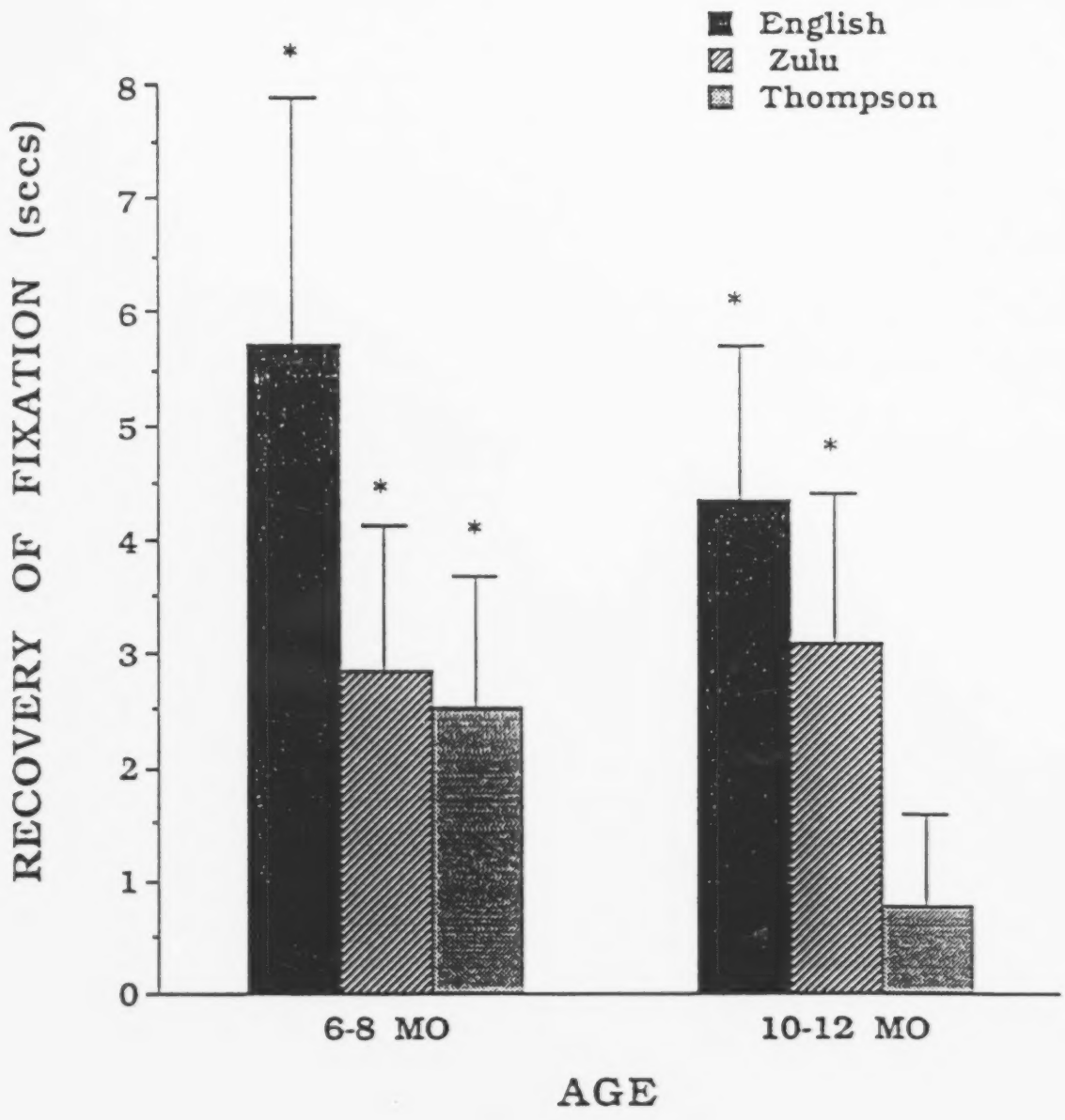

FIGURE 5. Discrimination results for each age group on the three contrasts, shown as the mean recovery of fixation during the 1st two trials following the stimulus shift, relative to the mean fixation time during the last two habituation trials.

* indicates significant fixation recovery after the stimulus shift

REFERENCES

Best, C. T., McRoberts, G. W., & Sithole, N. M. (1988). Examination of perceptual reorganization for nonnative speech contrasts: Zulu click discrimination by English-speaking adults and infants. Journal of Experimental Psychology: Human Perception and Performance, 14, 45-60.

Horowitz, F. D. (1975). Visual attention, auditory stimulation, and language discrimination in infants. Monographs of the Society for Research in Child Development, 39 (5-6), Serial Number 158.

Miller, C. L. (1983). Developmental changes in male-female voice classification by infants. Infant Behavior and Development, 6, 313-330.

Werker, J. F., & Logan, J. S. (1985). Cross-language evidence for three factors in speech perception. Perception & Psychophysics, 37, 35-44.

Werker, J. F., & Tees, R. C. (1984). Cross-language speech perception: Evidence for perceptual reorganization during the first year of life. Infant Behavior and Development, 7, 49-63.